

CLAIMS

Sub A⁷ What is claimed is:

1. A method for developing an object-oriented computer program that provides externalization of an object in the program, comprising:
including within a program code for providing in memory at runtime a
5 description of an object based on its one or more attributes.

2. The method of claim 1 wherein the description indicates the location in memory of an attribute.

3. The method of claim 2 wherein the description further indicates the amount of space occupied by the attribute.

10 4. The method of claim 3 wherein the description further indicates the type of the attribute.

5. The method of claim 4 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

15 6. The method of claim 5 wherein the description further indicates whether the attribute is an aggregate.

Sub A⁷ 7. The method of claim 3 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

20 8. The method of claim 2 wherein the description further indicates the type of the attribute.

9. The method of claim 2 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

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10. The method of claim 1 wherein the description comprises a list including an entry corresponding to an attribute of the object.

11. The method of claim 10 wherein the entry indicates the location in memory of an attribute.

12. The method of claim 11 wherein the entry further indicates the amount of space occupied by the attribute.

13. The method of claim 12 wherein the entry further indicates the type of the attribute.

14. The method of claim 13 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

15. The method of claim 12 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

16. The method of claim 11 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

17. The method of claim 1 further comprising including within the program second program code apart from said object for accessing said description at runtime.

18. The method of claim 17 wherein the description indicates the location in memory of an attribute.

19. The method of claim 18 wherein the description further indicates the amount of space occupied by the attribute.

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20. The method of claim 19 wherein the description further indicates the type of the attribute.

21. The method of claim 20 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

22. The method of claim 21 wherein the description further indicates whether the attribute is an aggregate.

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23. The method of claim 19 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

24. The method of claim 18 wherein the description further indicates the type of the attribute.

25. The method of claim 18 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

26. The method of claim 17 wherein the description comprises a list including an entry corresponding to an attribute of the object.

27. The method of claim 26 wherein the entry indicates the location in memory of an attribute.

28. The method of claim 27 wherein the entry further indicates the amount of space occupied by the attribute.

29. The method of claim 28 wherein the entry further indicates the type of the attribute.

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30. The method of claim 29 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

5 31. The method of claim 28 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

32. The method of claim 27 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

10 33. The method of claim 17 further comprising including within the program third program code apart from said object for producing a representation of an attribute of the object in a secondary format.

34. The method of claim 33 wherein the description indicates the location in memory of an attribute.

15 35. The method of claim 34 wherein the description further indicates the amount of space occupied by the attribute.

36. The method of claim 35 wherein the description further indicates the type of the attribute.

20 37. The method of claim 36 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

38. The method of claim 37 wherein the description further indicates whether the attribute is an aggregate.

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25 39. The method of claim 35 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

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40. The method of claim 34 wherein the description further indicates the type of the attribute.

41. The method of claim 34 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

42. The method of claim 34 wherein the description comprises a list including an entry corresponding to an attribute of the object.

43. The method of claim 42 wherein the entry indicates the location in memory of an attribute.

44. The method of claim 43 wherein the entry further indicates the amount of space occupied by the attribute.

45. The method of claim 44 wherein the entry further indicates the type of the attribute.

46. The method of claim 45 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

47. The method of claim 44 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

48. The method of claim 43 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

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49. A method for facilitating the development of an object-oriented computer program that provides externalization of an object in the program, comprising:

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supplying program code for providing in memory at runtime a description of an object based on its one or more attributes.

50. The method of claim 49 wherein the description indicates the location in memory of an attribute.

5 51. The method of claim 50 wherein the description further indicates the amount of space occupied by the attribute.

52. The method of claim 51 wherein the description further indicates the type of the attribute.

10 53. The method of claim 52 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

54. The method of claim 53 wherein the description further indicates whether the attribute is an aggregate.

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15 55. The method of claim 51 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

56. The method of claim 50 wherein the description further indicates the type of the attribute.

20 57. The method of claim 50 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

58. The method of claim 49 wherein the description comprises a list including an entry corresponding to an attribute of the object.

25 59. The method of claim 58 wherein the entry indicates the location in memory of an attribute.

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60. The method of claim 59 wherein the entry further indicates the amount of space occupied by the attribute.

61. The method of claim 60 wherein the entry further indicates the type of the attribute.

5 62. The method of claim 61 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

10 63. The method of claim 60 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

64. The method of claim 59 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

15 65. The method of claim 49 further comprising supplying for use by an applications developer second program code for accessing said description at runtime apart from said object.

66. The method of claim 65 wherein the description indicates the location in memory of an attribute.

20 67. The method of claim 66 wherein the description further indicates the amount of space occupied by the attribute.

68. The method of claim 67 wherein the description further indicates the type of the attribute.

25 69. The method of claim 68 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

70. The method of claim 69 wherein the description further indicates whether the attribute is an aggregate.

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71. The method of claim 67 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

72. The method of claim 66 wherein the description further indicates the type of the attribute.

73. The method of claim 66 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

74. The method of claim 65 wherein the description comprises a list including an entry corresponding to an attribute of the object.

75. The method of claim 74 wherein the entry indicates the location in memory of an attribute.

76. The method of claim 75 wherein the entry further indicates the amount of space occupied by the attribute.

77. The method of claim 76 wherein the entry further indicates the type of the attribute.

78. The method of claim 77 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

79. The method of claim 76 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

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80. The method of claim 75 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

5 81. The method of claim 65 further comprising supplying for use by an applications developer third program code useful for producing a representation of an attribute of the object in a secondary format apart from said object.

82. The method of claim 81 wherein the description indicates the location in memory of the attribute.

10 83. The method of claim 82 wherein the description further indicates the amount of space occupied by the attribute.

84. The method of claim 83 wherein the description further indicates the type of the attribute.

15 85. The method of claim 84 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

86. The method of claim 85 wherein the description further indicates whether the attribute is an aggregate.

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20 87. The method of claim 83 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

88. The method of claim 82 wherein the description further indicates the type of the attribute.

25 89. The method of claim 82 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

90. The method of claim 82 wherein the description comprises a list including an entry corresponding to an attribute of the object.

91. The method of claim 90 wherein the entry indicates the location in memory of an attribute.

5 92. The method of claim 91 wherein the entry further indicates the amount of space occupied by the attribute.

93. The method of claim 92 wherein the entry further indicates the type of the attribute.

10 94. The method of claim 93 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

95. The method of claim 92 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

15 96. The method of claim 91 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

20 97. A carrier of digital data signals for facilitating the development of an object-oriented computer program that provides externalization of an object in the program, comprising:

a program code signal for providing in memory at runtime a description of an object based on its one or more attributes.

98. The carrier of claim 97 wherein the description indicates the location in memory of an attribute.

25 99. The carrier of claim 98 wherein the description further indicates the amount of space occupied by the attribute.

100. The carrier of claim 99 wherein the description further indicates the type of the attribute.

101. The carrier of claim 100 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

102. The carrier of claim 101 wherein the description further indicates whether the attribute is an aggregate.

103. The carrier of claim 99 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

104. The carrier of claim 98 wherein the description further indicates the type of the attribute.

105. The carrier of claim 98 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

106. The carrier of claim 97 wherein the description comprises a list including an entry corresponding to an attribute of the object.

107. The carrier of claim 106 wherein the entry indicates the location in memory of an attribute.

108. The carrier of claim 107 wherein the entry further indicates the amount of space occupied by the attribute.

109. The carrier of claim 108 wherein the entry further indicates the type of the attribute.

110. The carrier of claim 109 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

5 111. The carrier of claim 108 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

112. The carrier of claim 107 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

10 113. The carrier of claim 97 further comprising a second program code signal for accessing said description at runtime apart from said object.

114. The carrier of claim 113 wherein the description indicates the location in memory of an attribute.

15 115. The carrier of claim 114 wherein the description further indicates the amount of space occupied by the attribute.

116. The carrier of claim 115 wherein the description further indicates the type of the attribute.

20 117. The carrier of claim 116 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

118. The carrier of claim 117 wherein the description further indicates whether the attribute is an aggregate.

25 119. The carrier of claim 115 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

120. The carrier of claim 114 wherein the description further indicates the type of the attribute.

121. The carrier of claim 114 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

122. The carrier of claim 113 wherein the description comprises a list including an entry corresponding to an attribute of the object.

123. The carrier of claim 122 wherein the entry indicates the location in memory of an attribute.

124. The carrier of claim 123 wherein the entry further indicates the amount of space occupied by the attribute.

125. The carrier of claim 124 wherein the entry further indicates the type of the attribute.

126. The carrier of claim 125 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

127. The carrier of claim 124 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

128. The carrier of claim 123 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

129. The carrier of claim 113 further comprising a third program code signal useful for producing at runtime a representation of an attribute of the object in a secondary format apart from said object.

130. The carrier of claim 129 wherein the description indicates the location in memory of the attribute.

131. The carrier of claim 130 wherein the description further indicates the amount of space occupied by the attribute.

5 132. The carrier of claim 131 wherein the description further indicates the type of the attribute.

133. The carrier of claim 132 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

10 134. The carrier of claim 133 wherein the description further indicates whether the attribute is an aggregate.

135. The carrier of claim 131 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

15 136. The carrier of claim 130 wherein the description further indicates the type of the attribute.

137. The carrier of claim 130 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

20 138. The carrier of claim 130 wherein the description comprises a list including an entry corresponding to an attribute of the object.

139. The carrier of claim 138 wherein the entry indicates the location in memory of an attribute.

25 140. The carrier of claim 139 wherein the entry further indicates the amount of space occupied by the attribute.

141. The carrier of claim 140 wherein the entry further indicates the type of the attribute.

142. The carrier of claim 141 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

143. The carrier of claim 140 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

144. The carrier of claim 139 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

Sub A 145. A computer system for developing object-oriented data processing applications that provide externalization of an object in a computer program, comprising:

a CPU;
a memory; and
one or more carriers of digital data signals wherein at least one of said carriers includes a program code signal for providing in memory at runtime a description of an object based on its one or more attributes.

146. The computer system of claim 145 wherein the description indicates the location in memory of an attribute.

147. The computer system of claim 146 wherein the description further indicates the amount of space occupied by the attribute.

148. The computer system of claim 147 wherein the description further indicates the type of the attribute.

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149. The computer system of claim 148 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

5 150. The computer system of claim 149 wherein the description further indicates whether the attribute is an aggregate.

151. The computer system of claim 147 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

10 152. The computer system of claim 146 wherein the description further indicates the type of the attribute.

153. The computer system of claim 146 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

15 154. The computer system of claim 145 wherein the description comprises a list including an entry corresponding to an attribute of the object.

155. The computer system of claim 154 wherein the entry indicates the location in memory of an attribute.

156. The computer system of claim 155 wherein the entry further indicates the amount of space occupied by the attribute.

20 157. The computer system of claim 156 wherein the entry further indicates the type of the attribute.

158. The computer system of claim 157 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

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159. The computer system of claim 156 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

5 160. The computer system of claim 155 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

10 161. The computer system of claim 145 wherein at least one of said carriers includes a second program code signal for accessing said description at runtime apart from said object.

162. The computer system of claim 161 wherein the description indicates the location in memory of an attribute.

163. The computer system of claim 162 wherein the description further indicates the amount of space occupied by the attribute.

15 164. The computer system of claim 163 wherein the description further indicates the type of the attribute.

165. The computer system of claim 164 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

20 166. The computer system of claim 165 wherein the description further indicates whether the attribute is an aggregate.

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167. The computer system of claim 163 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

25 168. The computer system of claim 162 wherein the description further indicates the type of the attribute.

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169. The computer system of claim 162 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

170. The computer system of claim 161 wherein the description comprises a list including an entry corresponding to an attribute of the object.

171. The computer system of claim 170 wherein the entry indicates the location in memory of an attribute.

172. The computer system of claim 171 wherein the entry further indicates the amount of space occupied by the attribute.

173. The computer system of claim 172 wherein the entry further indicates the type of the attribute.

174. The computer system of claim 173 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

175. The computer system of claim 172 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

176. The computer system of claim 171 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

177. The computer system of claim 161 wherein at least one of said carriers includes a third program code signal useful for producing at runtime a representation of an attribute of the object in a secondary format apart from said object.

178. The computer system of claim 177 wherein the description indicates the location in memory of the attribute.

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179. The computer system of claim 178 wherein the description further indicates the amount of space occupied by the attribute.

180. The computer system of claim 179 wherein the description further indicates the type of the attribute.

5 181. The computer system of claim 180 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

182. The computer system of claim 181 wherein the description further indicates whether the attribute is an aggregate.

10 Sub A 7 183. The computer system of claim 179 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

184. The computer system of claim 178 wherein the description further indicates the type of the attribute.

15 185. The computer system of claim 178 wherein the description further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

186. The computer system of claim 178 wherein the description comprises a list including an entry corresponding to an attribute of the object.

20 187. The computer system of claim 186 wherein the entry indicates the location in memory of an attribute.

188. The computer system of claim 187 wherein the entry further indicates the amount of space occupied by the attribute.

25 189. The computer system of claim 188 wherein the entry further indicates the type of the attribute.

190. The computer system of claim 189 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

5 191. The computer system of claim 188 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.

192. The computer system of claim 187 wherein the entry further indicates a description for the attribute that is based on the attribute's one or more component attributes if the attribute is a second object.